APPENDIX A

"CLEAN" VERSION OF EACH PARAGRAPH/SECTION/CLAIM
37 C.F.R. § 1.121(b)(ii) AND (c)(i)

SPECIFICATION:

Paragraph at page 1, line 4 to page 1, line 8:

BACKGROUND OF THE INVENTION

The present invention has an aim of providing a device for scanning register marks into a polychrome printing machine processing a sheet or a web material. This material, or print substrate, usually has an area for printing the image and a printing area for the accuracy control marks, marks usually known under the name of register marks, related to the setting into register of the different printing colors.

Paragraph at page 1, line 20 to page 1, line 25:

Many known devices, such as those described in documents CH690096, EP0401691 and US5747795, allow to register and scan these marks printed on sheet or web elements traveling in front of a light source. However these devices can usually scan only one register mark at the same time, which means that a polychrome print i.e. requires as many scanning devices as there are marks, that is to say colors into the print.

Paragraphs at page 1, line 34 to page 2, line 18:

Other devices, such as the one described in document EP0512448, propose to solve problems of selecting register marks which have the characteristic to be slightly contrasted with regard to the background color of the substrate on which they are printed; usually when the printed colors fade to paleness such as is the case for example with pastel yellow, cream or light blue. The above mentioned device allows to scan only one mark at a time, the latter being illuminated by a white colored light source. The light reflected by this mark is separated by two channels made of optical fibers at the end of which two filters of different colors are arranged and located in front of two photosensitive units. Each photosensitive unit is especially sensitive within a frequency range of a distinct color and produces an electric signal at the time of the register mark traveling. The mark scanning is achieved by means of a comparting/selecting

device which selects, among the generated electric pulses, the more representative one for the color mark.

When the aim is the simultaneous scanning of several register marks by means of the same device, the lighting of these marks becomes an increasingly significant component, particularly when a single, white or monochromic light source cannot make these marks more visible. Indeed, according to the color of the printed marks, the latter seem likely, under such a lighting, not to be sufficiently contrasted and to appear as invisible or, on the contrary, to generate dazzling or reflecting problems in the presence of specular colors such as gold color marks for example.

Paragraphs at page 2, line 24 to page 2, line 37:

Hence, in a whole third of cases, the printed colors are not so distinguishable from each other and require specific lightings in order to improve the real contrast either between themselves or in accordance with the background color of the printed pattern. Thus, a mark with a prevalence of green, purple or orange will appear all the more contrasted when its lighting color is full of complementary color, that it to say respectively in red, yellow or blue for the case.

In order to guarantee the reliability and the performance of the scanning systems, it is also obvious to make these distinctive marks quite apparent. Indeed, at the time of the start up of the printing machine, the first stage comprises the searching of the initially unknown positions for each register mark. This process is easier when each of the marks is illuminated by a source of appropriate color. In the same way, when these marks travel at significant speeds, i.e. up to 20 m/s, one will easily note that it is also obvious, even necessary, that these marks can be scanned without any possible doubt.

Paragraphs at page 3, line 8 to page 3, line 21:

SUMMARY OF THE INVENTION

The aim of the present invention is to overcome these disadvantages while offering a compact scanning device which allows, with a minimum of one scanning head, the simultaneous scanning of several register marks. Generally, several marks each require a scanning device equipped with a special lighting so as to present a sufficient contrast needed for

their scanning. The device according to the invention is advantageously able to scan some shifts between each color prints after simultaneous scanning of a reference mark and of one or more register marks by only scanning head.

This aim is reached thanks to a scanning head equipped with one or more lines of photosensitive elements, generally identical, and light issued from a light source for which one might alternatively modify the color and/or the intensity. The use of a plurality of different elements sensitive to particular colors related to the ones used into the printing, has a same action and can be considered as being another embodiment of the device.

Paragraphs at page 3, line 29 to page 4, line 5:

The simultaneous or nearly simultaneous scanning of these marks by this device depends neither on these marks' shapes, nor on their size, nor on their layout related to the others. Thus, the scanning of concentric and slightly contrasted register marks can be simultaneously scanned without any problem with the device of the invention, which will alternatively modulate its lighting color according to scanned marks in order to make them alternatively quite visible.

Appropriately, it is possible, for the already known shape of the marks to scan, to vary the alternation lighting periodicity in time or to vary the extension of the areas enlightened one by one. Hence, it could be useful to determine and set various lighting sequences being specifically convenient to the geometry of a certain kind of selected marks. Acting as an example, a continuation of such sequences could comprise the scanning of a group of several successive lines illuminated under a same color, then the scanning of a succession of lines alternatively projected one by one, in one color then in another, before getting back to the scanning of a group of several lines under the same lighting.

Paragraphs at page 4, line 16 to page 5, line 27:

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by studying a mode of realization selected as a by no means restrictive example an illustrated by the attached figures, in which:

- Fig. 1 is a schematic perspective view of said scanning device laid out upon a substrate printed with register marks,

- Fig. 2 is a strongly increased view of an example of a pair of register marks printed on a substrate by a polychrome machine,

- Fig. 3 is a strongly increased view of an example of a pair of concentric register marks as printed on a substrate by a polychrome machine.

- Fig. 4 and 5, are views of register marks of respective figures 2 and 3 as appearing under lighting areas, in two different illustrative scanning modes, during their simultaneous scanning by the device of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Fig. 1 is a schematic perspective view of device 1 of the invention. This device is arranged upon a substrate 2, traveling into a polychrome printing machine, so that it can easily scan the register marks 21, 22 printed on this substrate. The scanning device 1 comprises a box, line-dotted and partially represented, in which there are at least two light sources 3, 4, which allow both sources to project alternatively on the substrate 2 a lighting area 5 overlapping at least the area involved with the register marks 21, 22. Each source of light 3, 4 is usually composed of one or more light-emitting diodes 13, 14 such as the ones illustrated as an example in Fig. 1. The scanning device 1 also includes an optical device 6 allowing to project, on at least one photosensitive element 7, the image of a portion 8 of the substrate surface 2 which is illuminated in the area 5. Scanning portion 8 corresponds to an area the size of which is mainly selected to be related to the size of the register marks and to the contents of the operations plan of the scanning device. The latter defines in particular the image resolution of the aforesaid scanned register marks, as well as the run speed of these images by the scanning device according to the travel speed of substrate 2. The photosensitive element 7 can be a CCD sensor made up of a great number of pixels 17 generating electric pulses and forming, according to their amount and their location, one or more photosensitive areas located side by side. In Fig. 1, only one area of pixels 17 constitutes the photosensitive element 7 as illustrated. The latter is connected, like the scanning sources 3 and 4, to a microprocessor 9 which allows in particular to control the lighting

of these sources according to a registered mode and to deal with the pulses generated by each pixel 17.

The operating way of this device is intended to scan the register marks 21, 22 in their entirety by successively registering adjacent images portions 8, alternatively illuminated in one color and in another one, thanks to the light sources 3, 4. Each portion 8 of register marks is preferably scanned only once under the light of one of the light sources, the latter having lighting sequences controlled in time and duration according to the selected more into the microprocessor 9. The final image of the register marks obtained through this device will be easily recomposed by collecting successively all scanned portions 8 in the same order as the one previously defined at the register time by the traveling of substrate 2. Once recomposed, this image, or the included data, will then be used to define the possible shifts between the colors of the various prints during the operation of setting into register of the corresponding printing cylinders.

Paragraphs at page 6, line 17 to page 6, line 30:

Fig. 5 shows a reconstitution of the image of the concentric register marks of Fig. 3 from portions 8 of images scanned by device 1 in a different lighting mode than the one previously used. On this Fig., one easily detects the various lighting sequences constituting the selected lighting mode. The first sequence is performed by an alternation of a group 18 of three narrow contiguous areas 8a with a group 28 of three narrow contiguous areas 8b of another color. This succession of alternations is followed, in the central part of the register mark 32, by a second sequence of a succession of alternations of the areas 8a and 8b selected one by one, before entering again the first sequence issued from the alternations of groups 18 and 28. One can see, that, according to the shape and/or the size of a register mark, one can advantageously vary the alternation lighting frequency, either increasing either reducing the lighting sequence of light sources 3, 4, or opening a diaphragm at the level of the optic 6 so that the surface of portions 8 of images changes proportionally.

CLAIMS (with indication of amended or new):

11. (New) A scanning device for scanning register marks printed on a substrate, the device comprising;

at least one light source illuminating a lighting area on the substrate, the lighting area being an area on the substrate crossed by the register marks; the at least one light source that illuminates the substrate at the lighting area includes means for effecting at least one modulation of at least one of intensity and color of the illuminating light during simultaneous or sequential scanning of at least two of the register marks;

a photosensitive element comprised of a plurality of pixels for receiving traveling images of the register marks wherein the traveling images are comprised of a plurality of portions that are successively scanned according to a predetermined scanning rate and the pixels produce electric pulses;

a microprocessor connected with the at least one light source for controlling the lighting of the light source and for controlling the electric pulses produced by the pixels.

12. (New) The scanning device of claim 11, comprising at least two of the light sources which illuminate the substrate on the lighting area, with each of the light sources illuminating a plurality of portions of each of the register marks which portions are positioned to be successively scanned by the photosensitive element and each light source providing a respective modulation of at least one of intensity and color during the scanning of the register marks.

13. (New) The scanning device of claim 11, further comprising an optic disposed between the lighting area and the photosensitive element for directing light reflected from the lighting area to the photosensitive element.

14. (New) The device of claim 11, wherein the microprocessor is operable for causing the modulations of the illumination of the lighting area to be performed in synchronism with the scanning rate of the individual portions of the images.

15. (New) The device of claim 11, wherein the microprocessor is operable for causing the modulations of the illumination of the lighting area to be performed in synchronism with the scanning rate of each register mark.

16. (New) The device of claim 11, wherein the microprocessor is operable for causing the number of modulations per unit time to be the same as the number of portions of images scanned at the same time.

17. (New) The device of claim 11, wherein the microprocessor operates the light source in continuation of different modulations, and the lighting area is subject to illumination variations according to successive repetitions of at least one lighting cycle programmed and controlled by the microprocessor.

18. (New) The device of claim 17, wherein the microprocessor is adapted for establishing that during a lighting cycle, the amount of either different colors and intensity applied to the lighting area are proportional to the number of register marks of different colors that are simultaneously scanned.

19. (New) The device of claim 17, further comprising the light source supply for each color of the register marks supplies at least one of a light of the wave length ranging between 380 nm and 780 nm and an intensity between 5% and 100% of the maximum intensity for improving the contrast of the register marks compared to the substrate at the lighting area.

20. (New) The device of claim 11, wherein the photosensitive element comprises a plurality of pixels which are sensitive to at least one wave length of at least one printed color.

21. (New) The device of claim 11, wherein the microprocessor is operable such that with successively scanned portions located next to each other, the portions covering at least the entire surface of the register mark on the substrate may be simultaneously scanned.

22. (New) The device of claim 12, wherein the successively scanned portion of the images on the substrate are geometrically shaped and are of a width ranging between 0.1 nm and 5 mm.